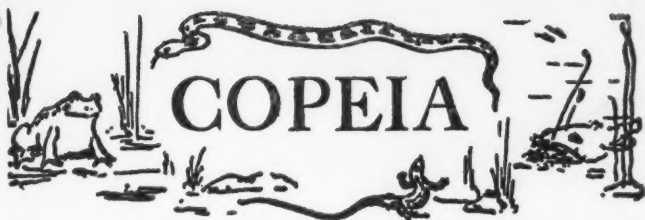


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A NOTE ON THE BREEDING HABITS
OF THE VIVIPAROUS PERCH
DAMALICHTHYS

Concerning the breeding habits of the Embiotocids, what appears to be the first note was made by P. B. Randolph (Am. Nat. 32. p. 305. 1928). His observation was made on *Damalichthys argyrosomus*, in July, some years before. The second note is apparently the one made by C. L. Hubbs (Copeia 47. 1917), on *Cymatogaster*.

On Dec. 20, 1928, I observed copulation in *Damalichthys*, at Monterey, Calif.

In July, 1928, I saw a large school of *Damalichthys* at Monterey, but they were not breeding. On Dec. 20, 1928, I saw another school from the fish wharf, in water which was approximately fifteen feet deep. The school was not very compact, and measured about thirty feet in length. The fish could only be seen with difficulty when they were swimming in the normal upright position, but my attention was attracted to them as they turned on their sides, exposing silvery ventral surfaces. The school remained but a few feet below the surface, and did not change its position to any great extent for a period of about fifteen minutes. During this time, pairs were continually observed, which were copulating. As many as six pairs might be seen performing this action at one time. Their performance was that of fish which had lost their sense of equilibrium; slowly circling, individually and in pairs, they turned over and over. When copulating, a pair would slowly turn upside down, in a rather irregular manner; they would both be headed in the same direction, with their tails and abdomens apparently about an inch apart, their heads would be somewhat more distant. Immediately on coming together, one of the pair would suddenly give a few flips of its tail and depart.

I could not tell whether their bodies came closer

than an inch; however, the oviduct of the female would be extended nearly that far.

It appeared as though the entire school was copulating. I could not see if an individual copulated more than once.

I could not get any of this school and consequently could not determine the condition of the females. It was not until Feb. 2, 1928, that I was able to visit Monterey again, and get a female of this species from the markets. It was a fish 138 mm. long; in its ovary were ten larvae about 13 mm. in length.

Though I am not sure, it seems quite probable that the females which I saw mating, contained larvae of about this size. These young would be expelled about May or June. If this be the case, my observation would differ to quite an extent from Hubbs', in that his *Cymatogaster* were giving birth to their young at the time of copulation, which was July; thus making the period between copulation and the birth of the young about twelve months in *Cymatogaster* and fifteen months in *Damalichthys*. It seems peculiar that the same species was seen copulating, by Randolph, in July, just six months from the time of year of my observation.

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HERPETOLOGY OF THE COLUMBIA, SOUTH CAROLINA, REGION

The following record embraces observations over a five year period of residence at Columbia, S. C., from September, 1921, to September, 1926. The writer was absent from the state, however, from the middle of June till the middle of September during each of the first four years and thus missed much of the profitable collecting season. Personal notes include solitary and class trips, some of which were of a general nature

and others specifically herpetological, and to these are added records of material captured by students, friends, and others and brought or shipped in to the zoological laboratory of the University of South Carolina, together with well authenticated local records, responsibility for which is indicated in the text.

Columbia lies in the Austroriparian Subzone and is situated on the fall line between the piedmont and coastal plain regions. It is also adjacent to a coastal plain belt of sand hills which traverses the central portion of South Carolina, and from so diverse a geologic background there has developed a wide variety of local environmental associations. The Saluda and Broad rivers, both piedmont streams, here unite to form the Congaree, a typical coastal plain river. On the right or west bank of the Congaree, opposite Columbia, is the town of New Brookland, to the north of which lies an ideal piedmont exposure with deciduous and pine woodlands, outcrops of huge granitic boulders, and clear swift streams having gravelly or sandy bottoms. These brooks are not densely surrounded with underbrush as a rule but permit easy access and the stream bed supports the weight of the wader. The sand hills are composed everywhere of sand and surface coverings of other types of soil are very rare. Streams are infrequent and the vegetation consists of stunted scrub oak, palmetto, and grasses, approaching desert conditions in many places. In the coastal plain the streams are very sluggish and muddy, with so thick a growth of blackberry bushes and other dense foliage as to be well nigh inaccessible, and with soft muddy bottoms which are usually too boggy to allow wading. Here the woods are typically much thicker and with heavier tangles of underbrush than in the piedmont. Marshes are common and the larger river bottoms form extensive swamps. The coastal plain, in this vicinity at least, is more populous than the piedmont and small farms abound, with here and

there larger plantations where corn and cotton fields provide good collecting grounds for snakes. In the immediate neighborhood of Columbia are a number of little ponds and lakes made by damming small streams and used by bathing clubs. The inlets of these ponds are marshy, usually with considerable fallen timber, and furnish excellent general collecting sites.

As would be expected by the herpetologist, but contrary to popular opinion, the wilder, denser, and more isolated districts are not often the best places to explore for lizards and snakes. A few species, as the Brown Water Snake (*Natrix taxispilota*), seem to prefer such a locality, but the majority are more frequently encountered in the vicinity of farms and out-buildings, where their food is present in greater abundance. Aquatic forms may be most easily observed and taken in the marshes adjacent to the artificial ponds, which are usually more open and accessible than older and remote marshes.

Very little recent zoological work has been done in this part of the state, upper and lower South Carolina having both received greater attention than the middle section. In the preparation of the present paper the writer has been especially assisted by two graduate students of the University of South Carolina, Miss Xepha Alford (1) having worked up the salamanders, and Miss Idolene McManus (6) the frogs and toads. Examples of most of the salamanders were sent to Dr. Sherman C. Bishop, at the New York State Museum, at Albany, who reported on them (2), and a few of my records have also been given by A. L. Pickens, of Greenville, S. C. (7, 8).

AMPHIBIA CAUDATA: I am satisfied that my memoranda in this group are by no means complete, and believe that further studies will yield a larger list. Piedmont collecting sites included the streams and banks of rivers and notably Newman's Woods, rich in urodele fauna, and consisting of deciduous and

pine growths with a clean and dry forest floor, numerous fallen logs and flat rocks beneath which the soil was moist, and a typical piedmont brook. This area covers about three acres and lies some two miles to the north, between the city and the Ridgewood County Club. In the coastal plain a number of situations were so fertile as regards their salamander content as to merit separate mention. Adams Pond Swamp, eleven miles southeast of Columbia, is located between a bathing pond and the Congaree River, and is a dense marshy and swampy tract with many small creeks and an abundance of fallen timber; the banks of the Columbia Canal within the city; and a marshy pasture fifteen miles to the south on the Orangeburg road.

Necturus punctatus (Gibbes), Carolina Mudpuppy. Locally common in streams and pools of the coastal plain. One example was taken from beneath leaves at the bottom of a small spring in a deciduous woodland, April 12.

Amphiuma means Garden, Congo Eel. I was never able to obtain this species, but heard of their capture with hook and line by negro fishermen in the river bottoms of the coastal plain. Several such specimens were described to me by Charles Adams and others with sufficient accuracy as to leave no doubt of their correct identity, but the captors could not be induced to bring in this salamander, which was regarded with great fear and reputed to be highly venomous.

Triturus viridescens viridescens (Rafinesque), Common Newt. Apparently rare. A few individuals in the red land stage and a single aquatic adult were all I could discover. These were taken in piedmont districts and I never succeeded in locating the coastal plain form, *T. v. dorsalis* (Harlan).

Ambystoma maculatum (Shaw), Spotted Salamander. Rare; a single specimen from Hopkins, in the coastal plain.

Ambystoma opacum (Gravenhorst), Marbled Sala-

mander. Abundant, coastal plain; common, piedmont. A large number of larvae were taken at various times in April, in the coastal plain only, and were identified for me by Dr. Bishop.

Ambystoma tigrinum (Green), Tiger Salamander. Rare; two individuals from coastal plain situations being the only specimens found.

Hemidactylium scutatum (Schlegel), Four-toed Salamander. This species was not encountered until my final summer in Columbia, when five were collected at Lakeview, an artificial pond in the coastal plain near the fall line.

Plethodon glutinosus (Green), Slimy Salamander. Abundant in all localities.

Mamculus quadridigitatus quadridigitatus (Holbrook), Dwarf Salamander. Not uncommon in low and moist woodlands of the coastal plain.

Pseudotriton ruber ruber (Sonnini), Red Salamander. Abundant in the coastal plain, less so in the piedmont. Nearly every fallen log in moist and especially in swampy woodlands will yield from one to half a dozen specimens.

Eurycea bislineata bislineata (Green), Two-lined Salamander. Very few were found until my final summer in Columbia, when over a dozen were taken in and around the bathing ponds. Occurs in both coastal plain and piedmont but more often in the former territory than in the latter.

Eurycea gutto-lineata (Holbrook), Holbrook's Salamander. One of the less common species, yet one or two could usually be turned up in each trip to suitable piedmont districts. Five in one journey to Newman's Woods was the best record made.

Desmognathus fuscus (Rafinesque), Dusky Salamander. This is by far the most abundant of the Caudata in the Columbia region, and occurs in a variety of situations, both aquatic and terrestrial, though never very far from water or in any except very moist surroundings. One could collect hundreds

within a short time with no difficulty in the coastal plain, and a smaller though still considerable number in the piedmont. Dr. Bishop, to whom I sent 22 specimens, stated that they approached *auriculatus* in color pattern, but were not absolutely typical. After looking over large numbers I could reach no decision as to their subspecific affinities; many appeared to be straight *D. f. fuscus*, but none seemed satisfactory as *auriculatus*. *Fuscus* is supposed to be a piedmont, *auriculatus* a coastal plain variety; but my animals, which may be termed roughly fall line examples, are indefinite and variable, and I suspect that a series taken through South Carolina from the mountains to the sea would probably bring about a revision of our ideas as to the status of these forms.

Siren lacertina L., Mud-eel. A number of immature and one large specimen were brought in from the swampy district below Adams Pond, in the coastal plain. They are said to be rather common in the creeks and "lakes" of river bottoms but the same difficulties attended their capture as were noted with *Amphiuma means*. Both are locally known as "Lampus Eels" or "Lamprey Eels" and highly feared.

AMPHIBIA SALIENTIA: All of the bathing ponds afford excellent spring collecting grounds for members of this group, especially about their reedy inlets, and the river swamps proved exceptionally prolific in anura. Just beyond New Brookland and near the fall line is a small coastal plain pond of about one acre in extent known as Horseshoe Lake. Rapidly filling with vegetation, it is very shallow and though having a muddy bottom permits wading throughout except during the period of highest water in the spring. This was a favorite locality and the one to which class trips designed specifically for frogs and toads were usually made. Other valuable fields include Taylor's Pasture, a west, grassy, and low-lying meadow adjacent to two ponds and a brook on the Columbia side of the Congaree River, some three miles below the

city; a similar environment along Crane Creek within the northern city limites; and a marsh below the Ridgwood Country Club, also to the north. These places and most of the following records are in the coastal plain, and I could find few suitable sites for this order in the piedmont near Columbia. Our list is doubtless fairly complete and representative for the region, but further collecting should bring to light two or three additional species in *Pseudacris*, *Hyla*, or *Rana*, whose known ranges make possible their capture in this vicinity. Any such forms must be locally rare though, as Miss McManus, the writer, and several others worked particularly on this group in carefully combing all of the more favorable areas.

Scaphiopus holbrookii holbrookii (Harlan), Spadefoot Toad. A single specimen taken in April under a pile of rubbish between a house and a small pool within the southern city limites. Intensive search failed to reveal any further examples, and I cannot but regard the species as uncommon here.

Bufo americanus Holbrook, American Toad. Abundant. A few in the piedmont.

Bufo fowleri Garman, Fowler's Toad. Very abundant, outnumbering other toads by a wide margin. Occasionally encountered in the piedmont.

Bufo quericus Holbrook, Oak Toad. Pre-eminently a sand hill species, where they are common and breed in transient standing pools or resort to the nearest marsh. At other seasons they may be collected only by chance in the sand hills, and occur in large groups, I am tempted to say "herds." One may tramp for miles and search carefully for many days without finding a single individual, then suddenly run across numbers of them within a limited area. Upon discovering one Oak Toad, our parties soon learned to spread out and hunt closely, always being rewarded with a good catch. If these little fellows are calling, their presence may be known at once as the note is very distinctive. But locating them is another matter

for the peep is deceptively loud, carries long distances, and is highly ventriloquial. I often recall with amusement my introduction to this species, when a party of seven students and myself looked vainly and with bewilderment for nearly two hours over a perfectly barren area in an endeavor to find the "sandpipers" we were sure were calling all about us. At last the puzzling notes were traced to the collecting buckets we were carrying about with us, and emanating from what we had indifferently taken to be merely "baby toads" at the time of their capture.

Bufo terrestris Bonnaterre, Southern Toad. Uncommon. I never could count upon getting this toad but ran across them only in sporadic cases. For example, a pond which yielded a breeding pair one season gave no more specimens thereafter.

Acris gryllus (Le Conte), Cricket Frog. The most abundant amphibian of the region and the only one which could be taken during every month of the year. Each roadside pool or ditch contained numerous individuals and the swamps and marshes literally swarmed with them. In the short winter season, here lasting from about the middle of December till the first week or two in February, Cricket Frogs were much less in evidence than at other times, and as collecting is then at its easiest it is clear that the majority hibernate. But even on the coldest winter days no difficulty attends the capture of a plentiful supply, which thus provides a dependable source of food for many of the snakes kept in laboratory cages throughout the year. Sporadically met with in the piedmont.

Pseudacris nigrita (Le Conte), Black Chorus Frog. Not uncommon in swamps and other low-lying situations, associated with *Acris* and in the breeding season with various *Hylas*.

Pseudacris ornata (Holbrook), Ornate Chorus Frog. Not common, judging from the fact that but two specimens represent all that could be found. These

were taken during April in boggy marshes near swamps.

Hyla cinerea cinerea (Schneider), Green Tree Frog. Common, though difficult to find except during the breeding season. Of summer captures I recall especially one very large adult who was sitting on a broad leaf immediately overhanging a small creek and which I did not distinguish until my nose almost touched him, and fifteen half-grown individuals found in early August perched upon the leaves of several wild rose bushes in a wet meadow near a little stream, constituting much the largest single collection of this species of which I have record. Occasionally they could be taken along the borders of woods, usually in low shrubbery, but there is no estimate possible of their frequency in such places as the great majority will doubtless be passed by unobserved.

Hyla crucifer Wied, Spring Peeper. Fairly common, though not as much so as in the north. We could always find them while breeding but rarely thereafter. Horseshoe Lake and the Wateree Swamps, the latter some 25 miles below Columbia, yielded the greatest number.

Hyla squirella Latreille, Squirrel Frog; Southern Tree Frog. Abundant, being the most widely distributed and commonly found *Hyla* in this district. After breeding they may be collected along the edges of woods and particularly at the base of a hill, in low shrubbery. In such situations I found them on the fall line but never in good typical piedmont territory.

Hyla versicolor versicolor (Le Conte), Tree Toad. Common. City parks provided one good source and the river swamps another.

Rana catesbeiana Shaw, Bullfrog. Common in the bathing ponds and occasionally taken at Horseshoe Lake and from transient pools in the industrial section of the city. There are not very many situations around Columbia suitable for this species.

Rana clamitans Latreille, Green Frog. Abundant,

principally in the bathing ponds and somewhat less so in the river bottoms.

Rana palustris Le Conte, Pickerel Frog. Not common, very few being recorded until Miss McManus discovered two or three fairly good collecting grounds, notably a marshy district below the cotton mill section of the city, bordering the river.

Rana sphenoccephala (Cope), Southern Leopard Frog. Abundant, being exceeded in numbers only by the Cricket Frog. This form occurs in the ponds, marshes, swamps, and in wet grassy meadows and moist woodlands of both zones. No examples of *Rana pipiens* were ever found nor did I note any intergradations between the two species such as are recorded by Pickens (7, pp. 109-110) at Greenville, where both occur.

Gastrophryne carolinensis (Holbrook), Narrow-mouthed Toad. Abundant, and except during the reproductive period invariably cryptozoic. In woods and swamps these curious little animals could always be collected in numbers by rolling logs, peeling the bark from fallen timber, and turning flat stones, tins, and tar paper. Not uncommon in the piedmont.

REPTILIA: LORICATA.

Alligator mississippiensis (Daudin), Alligator. I was not personally successful in finding this species, but have seen some of the occasional captures brought in from the river swamps, where they are said to be still fairly common in the more isolated and remote districts.

SQUAMATA; SAURIA. The list of lizards is complete, all six species that should occur here according to known ranges being plentiful and widely distributed.

Anolis carolinensis Voight, Chameleon. Abundant in woods and about farms and outbuildings in both piedmont and coastal plain.

Sceloporus undulatus (Latreille), Pine Lizard. A-

bundant in pine woods and on fences and piles of logs or lumber; occasionally met with in deciduous woods also. Occurs in both zones but is much more frequently observed in the piedmont.

Ophisaurus ventralis (L.), Glass Snake. Common in marshy, open, grassland localities and in rubbish heaps in woods and about settlements. Several were encountered within the city limits. Not taken here in the piedmont, though it ranges through upper South Carolina.

Cnemidophorus sexlineatus (L.), Six-lined Racer. Abundant, but found exclusively in a sandy environment, hence are characteristic inhabitants of the sand hills. I know of no situation around Columbia where there is even a small patch of sandy exposure in which these animals may not be discovered. The name Sand Lizard, as used by Pickens (8, p. 110) is thus entirely appropriate. Locally the species is usually termed Racehorse, indicative of the great speed and agility which makes their capture a very difficult matter, not many of the large numbers we pursued ever reaching the interior of a collecting bucket.

Leiolopisma laterale (Say), Ground Lizard. Abundant as a cryptozoic form in both piedmont and coastal plain, more so in the latter zone. They may readily be taken in all woodlands and the drier portions of swamps by peeling bark from or rolling fallen timber.

Eumeces fasciatus (L.), Five-lined Skink. Very abundant, being the most ubiquitous lizard of the region. They are perhaps somewhat more plentiful in the coastal plain than in the piedmont section. Individuals of all sizes in the blue-tailed estate are collected from logs and stumps and less commonly under stones. Red-headed adults are much rarer and to be looked for along fences and roadsides and in woodlands. The nesting habits of this species may be observed in the river swamps during May by stripping the bark from standing stumps. The female lies vertically coiled in a circle within a depression which

she has hollowed out of the decayed wood immediately beneath the bark. Within the circle of her body and also around the immediate periphery are the large and soft eggs, from ten to fifteen in number, of a seemingly incredible total volume for so small an animal to lay. All specimens so observed were in the blue-tailed phase. Many of the eggs were transported to the laboratory in unstoppered bottles of moist wood pulp, which was thereafter sprinkled with water as evaporation demanded, and within a week would hatch out tiny little skinks averaging 2 cm. in length and with the typical blue-tailed coloration.

SQUAMATA; SERPENTES. A very numerous snake fauna is to be expected in this state, and while large collections were made, I do not feel that the following list is by any means complete. However, since this is the group in which the writer is particularly interested, the search for specimens was intensive and it is unlikely that any species save those of rare or sporadic occurrence were overlooked in a five-year period of this type of work.

Carphophis amoenus (Say), Eastern Worm Snake. Common in both piedmont and coastal plain zones. All of the diminutive and secretive snakes, described as cryptozoic in this paper, were to be found in considerable numbers by stripping the loose bark from fallen logs and standing stumps, rolling the log and searching in the debris of dead leaves and twigs underneath, removing and digging into rubbish heaps of all sorts but especially under tins and old pieces of tar paper and composition roofing, and turning stones, either isolated or in piles. Fallen logs comprise the best of all such material, and pines are decidedly better than deciduous trees, the bark separating from the wood in large sheets.

Abaster erythrogrammus (Daudin), Rainbow Snake. Not common; not found here in the piedmont. The burrowing habits of this and the following species

renders an analysis of their frequency status difficult and uncertain.

Farancia abacura (Holbrook), Horn Snake. Fairly common, being more often taken than the preceding, but only in the coastal plain. I could never induce either species to feed in captivity, where they kept persistently beneath the soil of their cages. For this same reason neither snake is suitable for exhibition, despite their beautiful coloration and mild natures. *Farancia* was seen in the field only at dawn, and in the laboratory I surprised a specimen above ground several times at night, and so would surmise that this species and doubtless *Abastor* also are nocturnal.

Diadophis punctatus punctatus (L.), Southern Ring-necked Snake. Not very common, being considerably less frequent than in other southern districts where the writer has collected. Cryptozoic by day and roving by sundown, and taken only in the piedmont.

Heterodon contortrix (L.), Common Hog-nosed Snake. Abundant, occurring mainly in deciduous woods, but in the coastal plain only. The handsomest snake I have seen was the single black individual encountered, a large freshly shed adult taken in the sand hills. These snakes are of course known throughout the south as Spreading Adders, but the writer met with considerable success locally in overcoming the use of this objectionable term, which stresses the erroneous and superstitious belief in their venomous properties. The majority of my captive specimens soon became infected with or developed a skin disease which manifested itself by an ever increasing number of large oedemas just beneath the skin, accompanied by sluggishness, loss of appetite, difficulty in or cessation of shedding, and a general wasting away culminating in death. Curiously enough, no wild snakes were observed in this condition.

Opheodrys aestivus (L.), Rough Greensnake. Common in low woodlands and about the busy or grassy margins of ponds or marshes, but not collected in the piedmont.

I know of no Columbia occurrences of the Smooth Greensnake, *Liopeltis vernalis*.

Coluber constrictor constrictor (L.), Blacksnake. Commonly taken in such coastal plain environments as the sand hills, deciduous woods, and fields, particularly about farms.

Coluber flagellum flagellum (Shaw), Coachwhip. Not uncommon in the same situations as the preceding, but more especially in the sand hills. Neither were observed in the piedmont. The most difficult of all local snakes to capture, the Coachwhip retains its wild alertness in captivity but readily learns to take food from the hand. I found them to be by far the brightest and most intelligent of my captives, all of which except the Kingsnake and venomous species were kept in a large general cage, together with lizards, amphibians, and occasionally turtles. But the latter proved to be too much of a disturbing influence and were usually housed separately, for in the big cage they would blunder unconcernedly about, trampling upon all of the other occupants. Upon opening this cage and dangling a dead mouse from my fingers, the Coachwhip would dash forward at once with lightning speed, perhaps from the remotest corner, and would seize the presented food before any of the other rodent-eating species had even begun to take notice. Such behavior contrasts sharply with the usual stupidity or indifference displayed by most of our native serpents and with the eager but poorly co-ordinated reactions of garter snakes to proffered frogs.

Elaphe guttata (L.), Corn Snake. This beautiful reptile appears to be restricted to cultivated fields and the vicinity of settlements in the coastal plain, where it is common. In exploring a stump fields one hot afternoon in early August, I came across four level-topped pine stumps of from two to three feet in height which formed the corners of an area roughly three yards square. Upon each of three of these stumps reposed an immature Corn Snake, with a

young Blacksnake in the variegated pattern upon the fourth. Each animal was coiled and evidently enjoying his sun bath.

Corn Snakes have a peculiar habit which I have not seen described in print. If closely pursued in the field they will coil, or they may be encountered already coiled either abroad or in their laboratory cages. In any case the coiled serpent faces its opponent with its head lying within the loops. The neck region is depressed and on the substratum, so that the head points upward and outward at an angle of about sixty degrees, aims directly at the enemy and follows his movements. In this position the head is bobbed up and down in a very characteristic manner, the motions being entirely vertical and are first up and then back without pause; there is an interval of about one second between bobbings to that the process, while rhythmical, is jerky rather than continuous and may last for quite a long while if danger still threatens. Captive snakes soon lose this habit if frequently handled. The purpose of such behavior is evidently protective, with the design of warning or frightening the foe, and thus falls within that class of tactics which includes spreading, hissing, vibrating the tail and other snake manoeuvres which certainly have the desired effect upon most human observers and doubtless upon many of the lower animals as well.

Elaphe obsoleta obsoleta (Say), Black Ratsnake. Common in coastal plain fields and farms. Our largest specimen measured six feet four inches and was a powerful and showy animal. In the series collected I found the character of the number of temporal plates, often given to distinguish this from the following subspecies, to be highly variable and unreliable, but had no difficulty in separating them by means of pattern and coloration, which remain perfectly distinct even in very large individuals and exhibit no intergrading. A pair of these Black Ratsnakes mated in the general snake cage, pairing

beginning sometime during the early morning of May 25 and lasting six observed hours, thus probably some eight to ten hours altogether. After my absence for the summer and late in June or early in July, the female laid ten eggs which unfortunately dried up from improper care.

Elaphe obsoleta confinis (Baird and Girard), Gray Ratsnake. Less common than the preceding and usually taken in more moist situations, such as the head waters of the bathing ponds. One six foot example was captured deep within the Congaree River Swamp, far from human habitations, and one would judge from these observations that perhaps this subspecies is more partial to birds than to mammals and more so than is the Black Ratsnake, as small birds and eggs are plentiful in such localities while mice and rats are much less so than about farms. Nests full of the eggs or young of the house sparrow provided one of the easier methods of feeding both varieties of ratsnakes, a single individual cleaning out the whole nest slowly and methodically, as if realizing that he had plenty of time at his disposal, and then eagerly looking about for more when finished, searching all around and under the nest carefully. Dead mice or a nest of young rodents were readily accepted by both snakes and I was never able to get enough birds or mice together at any one time to fill up one of these voracious creatures. During public exhibitions mice were selected for feeding in order to stress the economic value of these snakes and I found that the use of the common name Ratsnake impressed the audience with this agricultural importance and would therefore urge its adoption in place of Chicken Snake, which calls attention to the relatively small amount of henhouse depredation of which they are occasionally guilty, or of Pilot Snake, which perpetuates an absurd superstition.

The present subspecies invariably proved more vicious than the Black form, and I would suggest this

as a psychological distinction between these closely related serpents. Caged specimens as well as those freshly caught would always bite when handled, whereas I never saw *E. o. obsoleta* offer to bite at any time except once when deliberately provoked. *Confinis* also employs the scent glands when captured, but our examples of the Black Ratsnake did not, though such an instance is mentioned by Ditmars (4, p. 305). One of our Gray forms exhibited the same movements of the head as detailed above for the Cornsnake, indicating a generic rather than specific rank for this characteristic.

Neither form was taken in the piedmont, nor could I establish a definite local record for the Four-banded Ratsnake, *E. quadrivittata*, though stories of their presence were not infrequent. No data on the Indigo Snake, *Drymarchon corais couperi*, could be obtained, and no local examples of the Pine Snake, *Pituophis melanoleucus*. A huge specimen of the latter, captured in the piedmont too far to the north to come within the province of this paper, was exhibited for some time in Columbia.

Lampropeltis getulus getulus (L.), Kingsnake. Very common, but taken in the coastal plain only. The principal collections were from marshy situations, less often in drier woods. This species is well and favorably known, being the only one which negroes and rural whites will not immediately kill on sight. Several instances of farmers encouraging their presence were obtained, one that I particularly recall being that of a venerable old white planter who gave us permission to collect snakes on his premises but warned us not to molest his pet Kingsnake. One specimen, Leo I, gained so great a local reputation for his prowess in overcoming and devouring any other snakes offered him in public exhibitions, that upon his death after nearly two years of captivity, the Columbia papers carried longer and more prominent obituary notices, with photograph, than for the passing of a statesman

of national fame, described in the same editions but without a portrait. My Kingsnakes were uniformly docile and seemed to enjoy being handled, but Leo I during his second year of cage life developed a strange irascibility and attempted to bite upon several occasions when first removed from his quarters. He was so clumsy about it, however, that his passes were easily avoided, especially since these reptiles do not strike but slide up to the enemy in a series of rapid advances and then take hold with deliberation but also with great power. His death was due to inability to shed, accompanied by refusal to feed and a complete wasting away.

Our Kingsnakes accepted all varieties of other snakes proffered them, ate their own kind as readily, and also took lizards, sparrows, and mice. Small prey was seized at any point and engulfed at once; large snakes were first constricted then either grasped by the head and laboriously swallowed, or by some other portion of the body, whereupon the conqueror would slowly work toward the head without releasing his mouth or coils, even though the quarry showed no signs of life. In such cases I have known the whole process to last for many hours, once in particular beginning during an exhibition at nine in the evening, being only partially finished when all spectators had left at midnight, and just on the point of final completion, with the tip of the victim's tail disappearing from sight when I arrived the following morning at eight. After so huge a meal the Kingsnake is not anxious to feed again for two weeks.

There can be no doubt that the majority of other snakes recognize and greatly fear the Kingsnake at sight, for upon introducing one of this species into the general snake cage, the occupants would be thrown into an absolute panic and dash furiously about in search of some avenue of escape. The entrance of freshly caught specimens of other snakes had no effect, nor did our snakes pay any attention to the

western species of Kingsnakes, *L. californiae californiae* or *L. getulus boylii*, both of which were placed in the general cage for this test. On the other hand, certain individuals of native South Carolina ophidians do not know or attempt to escape from the local Kingsnake. This strongly suggests recognition of this enemy as a psychological characteristic which would have decided and rapid survival value in the natural selection of intraspecific strains, and it would be interesting to determine whether or not this feature is hereditary.

Cemophora coccinea (Blumenbach), Scarlet Snake. Uncommon. But two individuals were captured, these being found beneath a lumber pile in the city, and just over the fall line in coastal plain territory.

Natrix septemvittata (Say), Queen Snake. Not common. Confined entirely to small piedmont brooks. I could not induce our few specimens to take food in captivity.

Natrix sipedon fasciata (L.), Banded Water Snake. Abundant, sharing front rank in occurrence with the Hognosed Snake. All of our examples are from coastal plain rivers, swamps, and ponds, with no records in piedmont streams. The Red-bellied form is less frequent than the typical, but runs to larger size and is locally held in decidedly greater fear by most persons, to whom it is known as the Copperbelly or Copperbellied Moccasin. My own experience has been that in this color phase the Water Snake is much more tractable and will more often permit capture and handling without resentment than will the typical form.

Natrix taxispilota (Holbrook), Brown Water Snake; a name not open to obvious objections as are the better known terms Water Pilot and Water Rattle. Not very common. They are restricted here to the wildest portions of the dense river bottoms in the coastal plain and hence it is difficult to estimate their abundance. I found our captives, some of which were of huge size, not to be as vicious as reported by Ditmars

(4, p. 258) and in fact to be very much milder of disposition than the common Banded Water Snake.

Seminatrix pygaea (Cope), Florida Water Snake. I here adopt the vernacular name employed by Pickens (8, p. 112) as being the most satisfactory for this species which I have yet encountered, there being as far as I can discover but three known instances of the occurrence of this small serpent beyond the confines of Florida, in parts of which it is fairly common. J. S. Schute found one in 1863 at Beaufort, N. C. (M.C.Z. No. 1341), and the writer (3) reported two from Columbia, S. C., the first taken at Horseshoe Lake, April 25, 1924, and the second at Lakeview, one of the several artificial bathing resorts, March 20, 1926. These two examples are deposited in the collections of the University of South Carolina, at Columbia. Both occurred in coastal plain environment, but very close to the fall line, and both were captured from beneath objects at the water's edge. The two localities are some seven miles apart, with a rather wide and rapid river, the Congaree, intervening. These specimens maintained secretive habits in the laboratory and would not feed.

Storeria dekayi (Holbrook), DeKay's Snake. Abundant as a cryptozoic form in both piedmont and coastal plain situations.

Storeria occipito-maculata (Storer), Red-bellied Snake. Not very common. Cryptozoic in the piedmont. *Virginia valeriae* could not be discovered.

Potamophis striatulus (L.), Brown Snake. Abundant, exceeding all other small and secretive species in numbers, and observed in both piedmont and coastal plain. Search of a small rocky hillside in the heart of Columbia yielded fifteen specimens in an hour's time one afternoon in April, but these were thoughtlessly put in a glass container together with a number of large millipeds, *Julus* and *Spirobolus*, and upon arrival at the laboratory a short while later all of the snakes were dead as a result of the fumes given off by the

myriapods. Each snake had suffered such violent muscular spasm as to become set in a series of stiff kinks which no amount of immersion or massage could completely overcome.

Thamnophis sauritus (L.), Eastern Ribbon Snake. Fairly common about streams and ponds in both zones.

Thamnophis sirtalis sirtalis (L.), Common Garter Snake. Rare, only about one specimen a year coming to my notice. These occurred in both zones, but more especially in the piedmont.

Tantilla coronata Biard and Girard, Crowned Snake. Rare, my records embracing but a single capture brought in from the northern section of the city, barely within the piedmont zone, and cryptozoic.

Micrurus fulvius (L.), Coral Snake. In spite of determined efforts to unearth this species, I was unable to ever find one and would regard them as at least uncommon locally. No living examples were brought to the University but dead and mutilated ones were occasionally received from planters or engineers, always from coastal plain territory.

Agkistrodon mokasen Beauvois, Copperhead. Common in piedmont situations at the northern edge of the city and at Ridgewood Club and Newman's Woods. I am indebted to Mr. Tom Taylor for a single coastal plain record, the largest Copperhead I have seen. This huge viper, slightly exceeding three feet, was taken in Taylor's Pasture, a low and wet meadow lying very close to the fall line. Upon kicking a recumbent log to pieces, Mr. Taylor dislodged two hibernating individuals of about the same size, one of which escaped. My caged snakes were of a very mild disposition and fed readily upon mice. The big fellow was also docile, but would not take nourishment until after two forcible administrations of sausages.

Agkistrodon piscivorus (Lacépède), Cottonmouth. Abundant in all streams, ponds, and marshes of the

coastal plain. While walking along the Canal one morning I noticed something swimming and took it to be a rabbit. Upon using binoculars I was astonished to discover that so large an object as to be comparable with a rabbit was but the head of a Water Moccasin! This enormous snake swam leisurely to the mouth of a small marshy stream just beyond the walls of the State Penitentiary and slowly disappeared in the reeds. I watched carefully as he drew his length out of the water and cannot believe that he would measure less than six feet, which is very large but not unknown for this species and which is accompanied by girth similar to that of a man's leg at the thigh. This formidable and doubtless aged monster was apparently dwelling in safety to himself and to mankind within the city limits and close by the most populous section, for this particular strip is almost inaccessible on account of the prison walls and is visited infrequently if at all.

On another occasion I had a narrow escape from a big fellow encountered in a remote district of lakes and cypress stands. This Moccasin was asleep at the base of a big tree by the lake margin, so I cut off his customary retreat and chased him away from the water to make more certain of a capture. The stick I had broken off and now employed to pin his head down snapped in two, and losing my balance in the slippery mud I fell down beside the thoroughly enraged snake. But instead of striking he continued a vain attempt at escape and soon was lodged in the collecting bag. I was usually sufficiently encumbered with binoculars, bucket, net and bag and so did not often carry while on hikes any form of prepared noose or stick for the apprehension of venomous snakes, relying on the simple method of pinning the head down with a rubber-booted foot except in the rather rare instances of very large vipers. Our captive Cottonmouths soon lost their aggressiveness but seldom could be induced to feed. Frogs and toads were tried out

and fish placed in the commodious tank of the special cage for venomous species, but usually to no avail.

Sistrurus miliarius (L.), Ground Rattler. Rare, a single individual from the sand hills being the extent of actual captures, with occasional reports of others. But I could never find them in any of the places which they were alleged to frequent.

Crotalus horridus L., Banded Rattler. Fairly common in the coastal plain, but I discovered no specimens or records of this snake locally in the piedmont, contrary to expectation. They may be found on hummocks and at the edges of clearings in swampy or marshy woodlands, in cultivated fields, and noticed more often than any other serpent as the victim of automobiles on the highways. A large Rattler was recently routed from the basement of a commercial firm in the center of the wholesale section of Columbia, having probably wandered up from the river by night. No positive local records of the Diamond-backed Rattler, *C. adamanteus*, were obtained.

TESTUDINATA: Nearly all of the species whose known range should include the Columbia district are here recorded, though in several instances by only a single observation. No one connected with the compilation of memoranda for this report made chelonians their especial concern and much work on the group remains to be done in this part of the state. I was not successful in securing many notes from piedmont situations, where suitable environments are not as frequent as in the coastal plain.

Sternotherus odoratus (Latreille), Common Musk Turtle. Plentiful, especially in Horseshoe Lake, the bathing ponds, and in drainage ditches of the coastal plain.

Kinosternon subrubrum subrubrum (Lacépède), Common Mud Turtle. Abundant in all ponds and streams. Sometimes taken in the piedmont.

Chelydra serpentina (L.), Snapping Turtle. Not very common. Occasional specimens were observed

in the Congaree River, both above and below the fall line, and several young were taken far up along small streams tributary to this river in the piedmont. One large adult was captured in Horseshoe Lake and infrequently one would also be discovered in the bathing ponds.

Clemmys guttata (L.), Spotted Turtle. Rare. I could not find this species and have only a single example sent in from a coastal plain pond.

Terrapene carolina carolina (L.), Common Box Turtle. Abundant in the humid coastal plain, common in the sand hills, and at times taken in the piedmont. Box Turtles were most usually found beside or beneath fallen pine logs in woodlands, but were also plentiful in swamps. Captive specimens made interesting exhibits and fed readily upon bread and vegetable scraps from the table. Several pairs mated in the turtle cage and one batch of five eggs were obtained but did not hatch. As Rosenberger (9, p. 765) notes, the males maltreat the females while breeding.

Chrysemys picta (Schneider), Eastern Painted Turtle. Uncommon; only a few encountered in coastal plain marshes and ponds.

Pseudemys concinna (Le Conte), Barred Terrapin. Holbrook (5, vol. I, p. 120) mentions this turtle as occurring in the Congaree River above the fall line, a section of this drainage system known today as the Broad River, but I was unsuccessful in attempting to locate it there or elsewhere.

Pseudemys rubriventris (Le Conte), Red-bellied Terrapin. Rare; a single specimen found in a coastal plain pond.

Pseudemys scripta (Schoepff), Yellow-bellied Terrapin. Abundant, being by far the most numerous chelonian species of the region. A few came from the piedmont, but in the coastal plain every pool, stream, lake and swamp abounded with these cooters, sunning themselves upon logs and sliding quietly into the

water at the first sign of danger. The largest one I ever encountered was taken within the city limits while crossing a dirt road toward a small, slightly marshy field.

Dierochelys reticularia (Latreille), Chicken Turtle. Rare; a solitary capture in a coastal plain pond.

Amyda ferox (Schneider), Southern Soft-shelled Turtle. Probably fairly common in the larger rivers. The only individual I observed was seen from a bridge over the Congaree between Columbia and New Brookland. It was swimming lazily on the surface of the water not three feet distant from a similarly engaged Snapping Turtle.

SUMMARY. Abbreviations used: P—taken only in the piedmont. CP—only in the coastal plain. B—in both zones.

Salamanders—14. P—2; CP—7; B—5.

Frogs and Toads—17. P—0; CP—12; B—5.

Total, Amphibia—31. P—2; CP—19; B—10.

Crocodilians—1. P—0; CP—1; B—0.

Lizards—6. P—0; CP—2; B—4.

Snakes—28. P—4; CP—18; B—6.

Turtles—11. P—1; CP—5; B—5.

Total, Reptiles—46. P—5; CP—26; B—15.

Grand Total—77. P—7; CP—45; B—25.

Zone Total: P—32; CP—70.

It thus is seen that in number of herpetological forms the coastal plain is more than twice as well supplied as the piedmont, and has more than six times as many unique species. In numbers of individuals the disparity is much greater, possibly as high as a hundred to one. This is due not only to the fact that coastal plain topography is in general more favorable to all of these groups save lizards, but also to the absence of many suitable piedmont collecting sites near Columbia.

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MELANISM IN THE GARTER SNAKE, *THAMNOPHIS S. SIRTALIS*, IN ONTARIO

Melanism occurs commonly in the garter snake, *Thamnophis s. sirtalis*, in certain localities on the north shore of Lake Erie. In the Canadian Field-Naturalist, Vol. XXXIII, No. 3, Mr. Clyde Patch recorded the capture of three melanistic individuals at Point Pelee, Ont. In the same periodical, Vol.

XXXIX, No. 5, I recorded the capture of one more black specimen of this species, also at Point Pelee.

In the summer of 1927 I spent several weeks at Long Point, Norfolk County, Ontario, where *Thamnophis s. sirtalis* was very abundant and melanism exceedingly prevalent.

A number of specimens were collected and brought to the University of Toronto where they were kept alive at the Department of Biology.

Five pregnant females were isolated in separate cages and when their litters were born the black and normally coloured young in each litter were counted by Mr. W. J. LeRay in whose charge the specimens were. The figures for these are as follows:

YOUNG OF TWO BLACK FEMALES

Sept. 20	Normal colour	5	Black	15	Total	20
" 27	" "	13	"	13	"	26
		<hr/>		<hr/>		<hr/>
		18		28		46

YOUNG OF THREE NORMAL COLOURED FEMALES

Oct. 3	Normal colour	8	Black	12	Total	20
" 5	" "	10	"	12	"	22
" 8	" "	9	"	5	"	14
		<hr/>		<hr/>		<hr/>
		27		29		56

It will be seen from the above figures that out of 46 young born of two black females, 28 or 60.87% were black; and out of 56 young born of three normal females, 29 or 51.78% were black.

Out of a total of 102 young born of these five females, 57 or 55.88% were black.

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